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☞ We request the attention of our readers to the article in this number entitled "English and American Railroads." We have reason to believe that it comes from a gentleman who from vast experience and information, knows when and where to institute comparisons, and independently of the merit of the article, its authority renders it worthy of notice.

In the number of this Journal for April 1st, we published an article containing strictures upon Prof. Renwick's paper, appended to the last edition of Tredgold on the Steam Engine, etc. The tone of these remarks is not as calm and philosophical as it might be, we should rather say—as it ought to be. Had the writer been more sparing in his epithets, and exhibited less warmth of manner, we think far more weight would have attached to the article in question, than in its present form. However, we are not now about to quarrel with words—neither do we profess an intimate acquaintance with the detail of certain historical questions—but we propose at present to point out a few portions of the paper which appear to need particular notice.

The following remark occurs in the paper of Prof. R. "in a treatise on the steam engine, which it is believed had some influence in the improvements that have since been made in navigation by steam, it was demonstrated, that a power of a given engine might be doubled by loading the safety valve with 57 lbs. per square inch, and cutting off the steam when 1-8 of the cylinder has been filled, and a saving of 2-5ths of the fuel effected at the same time." It is thus replied to by Mr. Ward. "If by a 'given engine,' in this passage, is meant one worked by steam of the force of 4 or 5 lbs. per square inch, we have to remark, with due deference to the demonstrator, that practice has, and ever will, and inevitably must prove this and all similar demonstrations, to be drawn from erroneous premises." If this is correctly understood by us, it is, we conceive a most sweeping assertion,

not borne out by "practice." To prove, however, that it is borne out, a table is introduced, showing the "relative consumption of fuel by the British engines, which use low steam, and some of the fast running American boats, which are worked by steam approaching pretty nearly to the economical pressure of 57 lbs. per square inch."

To render this table complete, we should have the *average velocity* of the vessels—the number of strokes per minute, and the area of the immersed portion of the transverse section. We should then be able to form some idea of the proportion of the engines to the vessel, and of the amount of power expended in obtaining high velocities. Without these elements the comparison, to be fair, should only be between vessels having the same size and moving at the same rate. We should then be better able to oppose "facts" and "theory."

It is hardly necessary to refer in this place to the various statements to be found of the value of the "expansion" mode of working. But two references will suffice. Dr. Lardner in his work on the steam engine, after pointing out the error of Woolf's views, as set forth in his patent, says, "yet so far as his invention suggested the idea of employing steam at very high pressure, and allowing it to expand in a much greater degree than was contemplated either by Watt or Hornblower, it became the means of effecting a considerable saving in fuel, for engines used for pumping on a large scale, the steam being produced under a pressure of forty or fifty pounds, or more upon the square inch," etc. He then goes on to say, that this principle is now applied in the form originally proposed by Watt.

But lest it should be asserted that Dr. Lardner's statements are *theoretical,* we beg leave to refer to the article in the first volume of the Papers of the Institution of Civil Engineers, for a full account of the measured duty of the Cornish engines, together with their consumption of fuel. In these engines the pressure is raised to about 40 lbs. to the square inch, and the steam is cut off at one-third, one-fourth one-fifth, one-eighth, or even one-tenth of the length of the stroke, according to the work. In the English Journals, numerous statements under the highest authority, show the economy of this mode of working steam, and although intended for quite different purposes, these engines will give some idea of the value of the principle.

The next criticism is upon the opinion expressed by Professor R. as to the mode of improving the performance of the Great Western, stigmatised by Mr. Ward as "grossly erroneous and highly mischievous." This opinion is as follows, "on examining this vessel and comparing her performance with that of American steamboats, it is easy to perceive that her speed might be very materially increased, without making any important change in her engines, and probably with a saving of fuel. It would be necessary to modify the boilers so as to convert a less quantity of water than they now do into steam, but to furnish it of a tension of 20 or 30 lbs. instead of $3\frac{1}{2}$, which they now carry, nor when the boiler is of sufficient strength, need any increase of danger be apprehended from using steam of this medium pressure. It is now well established, that the mere pressure

of steam is among the least important causes of danger, and that such as are most to be apprehended are as likely to occur in using steam of a single atmosphere, as that of ten or twelve." The comment runs as follows, "This whole paragraph is made up of errors; but the last sentence, in which is repeated the absurd and dangerous idea that the *pressure* of steam has little or nothing to do in the bursting of boilers, when such disasters occur, is the most surprising. What else than the pressure of steam ever yet produced an explosion in a steam boiler? What else can find a place in a steam boiler, while at work, to produce one? The existence of any other cause has not only never been proved, either by reasoning or experiment, but the non-existence of other causes which have been supposed to produce explosions, may be inferred from the circumstance, that in every case where the facts could be made out, after an explosion has occurred, the pressure of steam has been found to have been abundantly sufficient to produce the effects observed; and when the same conclusion *must* be arrived at by reasoning from the known laws of caloric vapor, it is melancholy to find such an opinion promulgated to the world through such a channel, and with the sanction of a respectable name—and it is to be hoped that further reflection, etc." Here is a very serious misapprehension of the latter portion of this "unfortunate opinion." How any one can construe the statement that "the *mere* pressure of steam is among the least important causes of danger," into one like this, "the *pressure* of steam has little or nothing to do in the bursting of boilers," it is not easy to conceive, if we bear in mind the meaning of the English word *mere*. If in the first sentence we substitute the words "existence of a boiler," for the words "pressure of steam," and we shall have by this new mode of translation, "the existence of a boiler has little or nothing to do in the bursting of boilers." In fact, the whole concluding paragraph contains an insinuation that Professor Renwick believes in the existence of some mysterious agent capable of bursting boilers, *ad libitum*. Where such belief is expressed, we cannot say; and it is rather remarkable, that in all the writings, conversations, or lectures of Professor Renwick, his opinion should have lain dormant until elicited by this new mode of translation.

But lest we should be considered as evading, by a mere form of words, we beg once more to refer to authority. Mr. Redfield, in his communication made to the commissioners appointed by the English Government for conducting an inquiry into the causes of steamboat accidents and the practical means of preventing their recurrence, has the following. "That the safety of steam boilers from explosions does not necessarily depend upon working with so low a pressure as five or seven pounds to the square inch, and that a reasonable increase in the proportionate strength of the boilers in steam vessels would remove all immediate hazard, and nearly end the catalogue of these disasters, is rendered apparent by the facts which relate to this branch of navigation as it has been carried on in various directions from the city and port of New York." Again, "It must not be supposed

however, that the average pressure of steam now used on the New York steamboats can be greatly increased, without incurring material hazard. The thickness which is found most suitable for boiler metal and the practical and economical limits of form and size, are such as should prevent us from allowing a maximum pressure exceeding one and a half or two atmospheres above the common boiling point, for condensing engines; and an addition of about one atmosphere for high pressure engines, which are worked without a condenser and air pump. To these limits, *if an adequate system of boiler construction be adopted*, the pressure may with safety be carried, as is done in locomotive engines, in the use of which, owing to a better system of construction, fatal accidents have been less frequent, perhaps, than with low pressure marine engines."

In making the foregoing remarks, we have not pretended to advocate any system of extra high pressure, but merely to point out the fact, that the opinion so severely remarked upon, is not an uncommon one, and that we have the authority of a *practical* man, and a very cautious one too, for considering that there may be another opinion than the one entertained by Mr. Ward.

The testimony of almost all practical and well informed men is, that the *mere* use of steam of 40 or 50 pounds pressure per square inch, as in locomotive boilers, etc., is not the *cause* of danger; and that the use of such pressures in boilers of competent strength, skilfully and carefully managed, is less dangerous, if not more economical, than a low pressure, depended upon as safe, merely because it is a low pressure.

For the American Railroad Journal and Mechanics' Magazine.

ENGLISH AND AMERICAN RAILROADS.

I have lately seen the last half yearly reports of several English railway companies, and thought that a comparison of the results contained therein with those of the American railroads, would be of some interest for your readers, and as the railroads constructed in Massachusetts bear the most resemblance to the English, I have chosen for a comparison the railroads near Boston, for which the last "Annual reports of the railroad corporations in the State of Massachusetts," furnish the necessary data.

The following statement is extracted from the reports of five of the most frequented railroads in England.

Name of Railroad.	Length in miles.	Cost of whole road.	Cost per mile.	half yearly gross receipts.	half yearly expenses.	Nett profit.	Proportion of receipts to expenses.
		£	Dolls.	Dolls.	Dolls.	Dolls.	
Liverpool & Manchester	32	1,398,552	211,909	706,878	401,483	305,395	100 : 57
Grand Junction,	79 1-4	1,900,000	94,756	1,099,422	523,218	576,204	100 : 48
London & Birmingham,	112 1-2	5,600,000	241,422	1,674,385	681,202	993,183	100 : 41
London & Greenwich,	3 3-4	608,000	786,347	134,078	90,914	43,164	100 : 68
Leeds and Selby,	20			134,054	98 256	35,798	100 : 73
Total,	265 1-2			3,748,817	1,795,073	1,953,744	100 : 48

In making the reductions, the pound Sterling is taken at four dollars eighty-five cents.

The average cost per mile of the above first four railroads with an aggregate length of 245½ miles, is 38,723*l.*, or $187,706, while the average half yearly receipts are $14,120 per mile, being at the rate of 15 *per cent* annually in the cost of the railroads; at the same time the expenditure per mile of road was for the half year 6761 dollars, equal to 48 per cent. of the gross revenue, and leaving 7359 dollars as the net profit, which is at the rate of $7\frac{84}{100}$ or nearly 8 *per cent. per year on the cost of the roads.*

It therefore appears that although the railroads in England are constructed at an enormous expense of 187,706 dollars per mile, the nett income per year is nevertheless 8 per cent. on their cost, which favorable result can only be attributed to the immense number of passengers, conveyed annually over these roads. The number of psssengers which passed over the London and Birmingham railroad in the year 1839, was 608,564, of which each performed, at an average, a distance of sixty-five miles. The number of passengers on the Greenwich railroad during the same year, was 1,513,455.

The following is now an analogical statement of five railroads in America, showing the results of their operations in the year 1839.

Name of Railroad.	Length in miles.	Cost of whole road.	Cost per mile.	Yearly receipts.	Yearly expens's	Nett profit.	Proportion of receipts to expenses.
Boston and Lowell,	26	1,608,476	61,864	241,220	92,151	149,069	100 : 38
Boston and Providence,	42	1,850,000	44,048	313,907	100,031	213,876	100 : 32
Boston and Worcester,	44 1-2	1,848,085	41,530	231,807	126,385	105,422	100 : 55
Nashua and Lowell,	15	353,662	23,577	55,054	28,658	26,396	100 : 52
Eastern,	13 1-2			125,623	53,176	72,447	100 : 42
Total,	141			967,611	400,401	567,210	100 : 41 2-5

The average cost per mile of the first four railroads is $44,394; the Eastern railroad has only been in operation through the year, on a length of 13½ miles, the cost of which will not materially differ from the average of $44,394 per mile. The English railroads above specified, are therefore 4¼ times more expensive than those near Boston; the latter have, however, for the greater part, only single tracks, while the English have double tracks throughout.

The gross income per mile of road, was $6862, or 15½ per cent. of the cost of the roads, which is very near the same as on the English railroads. The expenditure per mile was $2840 (41 per cent. of the income,) leaving as nett revenue per mile $4022, or *nine per cent.* on the capital expended. Thus it appears that while the gross receipts bear the same proportion to the cost of the railroads both here and in England, the expenses are less here, leaving therefore a greater nett income in proportion to the capital invested.

It is a known fact, that the expenses on railroads do not grow in the same proportion as the traffic increases, and the greater the latter therefore, (the charges for transportation remaining the same,) the better proportion will

the nett profit bear to the gross receipts; that is, while the nett profit on the railroads in Massachusetts is now 59 per cent. should the traffic increase four-fold, the nett profit would be 70 or more, per cent. of the gross receipts. Now the gross receipts on the English railroads above mentioned, *are* four times as large as on those in Massachusetts, the charges for transportation there, being at least, equally high, and the nett profit is only 52 per cent. of the gross revenue; thus showing that the management of the railroads in America, is in a considerable degree cheaper than in England.

Your's truly,

K.

A Constant Reader of the Journal.

Philadelphia, April 6, 1840.

For the American Railroad Journal and Mechanics' Magazine.

Cuba, Allegany Co., March 27th, 1840.

Messrs. Editors—If the writer of the article on crank motion in your last number (March 15th) will examine Tredgold on the steam engine, vol. I, appendix, p. p. 173 to 182, new edition by Weale—he will find a correct general investigation of the crank motion, by W. S. B. Woolhouse, F. R. A. S., &c.—from the concluding remarks of which, I have copied the following, which may be interesting to some of your readers.

Yours, &c., Henry Tracy.

"We have gone thus far into an investigation of the motion of the crank, as it forms one of the most important instruments of the steam engine, and has hitherto met with very little attention from scientific writers. It is, doubtless, the most simple, and perhaps the most efficient, contrivance, that can be devised to convert a reciprocating into a rotatory motion; and in this respect we cannot be surprised that it has not been superseded by any of the numerous inventions that have been proposed with the view of dispensing with it. We are compelled, however, at the same time, to admit that this beautiful simplicity is accompanied by corresponding inconveniencies, in the inequalities of motion, pressure, friction, and consequent wear. The mechanical defects of engines constructed on the rotatory principle appear to be of greater magnitude, and the disadvantages and difficulties that stand in the way of their application to the most important uses, are of a very formidable nature. This is much to be regretted, as we conceive a perfectly equable motion to be a great desideratum in the steam engine; and the only hope we can have of succeeding in obtaining it is in the exclusive employment of rotary action. On this head we may refer our readers to an instructive paper, entitled "On the Fallacies of the Roatry Steam Engine," by John Scott Russel, Esq., a gentleman to whom practical science is much indebted. One of the leading objects of this paper, which is printed in the Edinburgh New Philosophical Journal for Janurry, 1838, is to show that no loss of power is sustained by the intervention

of the crank; but, in doing this, it should be remarked that the author has throughout this paper discussed only the particular case in which the power moving acts on the crank in parallel lines, or in which the connecting rod is supposed to be of infinite length, and that this necessarily reduces many of his statements into mere approximations, when the subject is generally considered. Mr. Russel has, however, handled the subject with considerable power, and his remarks are, perhaps, sufficiently precise for the object he had in view, viz., to dispel the delusion under which many practical men labor, with respect to the nature of the crank, that it is attended with a loss of nearly one-third of the power. It is well known that persons are to be found who have been the subjects of this delusion, as well as inventors who have been its victims, but we cannot concur with Mr. Russel, "that some eminent standard writers on the steam engine have advanced the same doctrines." Most writers who are accostomed to treat these matters scientifically have doubtless considered that no reasonable dispute could possibly be entertained, and have thought it unnecessary to make any declaration on the point in question. We may, however, be allowed to refer to one exception. At page 137 of "Hann & Dodd's Mechanics for Practical Men," the very question is taken up, and comprehensively disposed of in the following paragraph:—

"'In the crank, as applied in the steam engine, the effect which is produced is to the effect, were the force to act perpendicularly on the crank all the way round, as twice the diameter of a circle is to the circumference; in consequence of which, many practical men have considered that there is a corresponding loss of power by using a crank; without even considering that the piston, or moving power, only moves through twice the diameter of the crank's orbit, while the crank moves through its whole circumference. For here the same principle holds good, as in all other mechanical contrivances, viz., the power multiplied by the space which it passes over, is equal to the weight or resistance multiplied by the space which it passes over.'"

"These statements have since found their way into other mechanical works of more recent date; and it is certainly of some moment that practical men who have not the means of following out theoretical investigations of these subjects, should be thus guarded from an error by which many of them have been as widely misled. That no power is gained or lost by the use of the crank has already been established on dynamical principles at the commencement of this paper. We are not, however, to conclude that this principle is at all peculiar to the crank. It is well known to apply to every combination of the five elementary powers, and by the principle of virtual velocities it may easily be shown that it is an universal property of mechanical arrangement, *that with every possible mechanical combination, no power can be gained or lost, if we except the resistance occasioned by friction.*"

For the American Railroad Journal and Mechanics' Magazine.

THEORY OF THE CRANK.

Permit me to make a few remarks in reply to Mr. W. R. C.'s communication, who says, that my "*theory*" appears to be founded on a mode of representing a given force by a surface, instead of, as usual, by a line.

Whoever will take the trouble to examine my communication with attention, will see, that no such error has been committed, which indeed would be too palpable to escape the notice of any one, who is at all versed in mathematics. It appears, that Mr. C. in his critique, was impressed with the same idea, which led him to the discovery of the grand error in Dr. Lardner's publication on Railway Constants.

There is a distinction between a *resting force*, (a dead pressure, or a power in a state of quiescence,) and a *moving force*, which is exerting itself. The *resting force* or *pressure* of the prime mover is the power, with which it is ready to act at any moment; the *moving force* or *motive power* is the *momentum* of the pressure, and equal to the product of the pressure into the space, through which it has moved. The simple dead pressure or its measure may be represented by a straight line, and also the space through which it has moved. The product of both, or the *momentum of the power*, or what is the same, *the amount of power expended*, is therefore to be represented by the area of the rectangle, the sides of which correspond to the pressure and the distance of its motion.

The term *momentum* is also used to express the product of a pressure into a leverage. I have made use of that term in both senses, because they are essentially the same.

Mr. C. says, further, (page 205,) "the crank pin has therefore moved 11·48 times further than the power, and if the force with which it has moved through this distance, be in the inverse ratio of the length of the arc a 1 to the line a 1$''$, the dynamical effects will be the same."

This is a demonstration on the principle of virtual velocities, *what is gained in space is lost in power*, and if this principle was as well applicable to rotary motions as to straight motions, the matter would be simple enough. But I contend, that the above principle is not directly applicable to the case in question, but that the change of a reciprocating straight motion into a rotary motion, is attended with a loss of power. If the crank pin was moving in straight lines, then the dynamical effects would be equal.

You will please to recollect, that the laws of rotary motion are as yet but imperfectly understood, and that those who applied the principles of straight motion, to rotary motion, as in the case of the crank, did so, without reflecting much on the matter, and because it had never been properly investigated.

The last remarks of Mr. C. with respect to the connecting rod are correct. This consideration, having no direct bearing on the question, was

omitted by me. The connecting rod is supposed to be infinitely long, and the direction of the moving force therefore always parallel.

Yours very respectfully,

JOHN A. ROEBLING.

Harrisburg, Pa. April 8th, 1840.

For the American Railroad Journal and Mechanics' Magazine.

HASSARD AND CO.'S FRAME BRIDGES.

The frame bridges as erected on the Western, Norwich and Worcester and Housatonic railroads, are on the plan of Hassard & Co., their construction being somewhat different from any heretofore erected, we propose describing, as clearly as we can without reference to a drawing, some of the principal features wherein they differ from a plan for which the Engineer department have been long and greatly indebted to Col. S. H. Long.

The counter braces, as used in Col. Long's patent, are dispensed with. The truss frames are of large dimensions, giving broad and strong shoulders in the posts for the panel braces, and to prevent a too great strain upon these shoulders, arch braces are introduced bearing against the upper centre string, and running from between the posts of each panel, conveying the load directly to the abutments or piers, and thus relieving the panel braces. To prevent the upper inside shoulders of the posts from receiving the whole pressure which would be applied to them by the arch braces bearing against the upper centre string, the arch brace is shouldered into a deep bearing piece which runs between the posts under and against the upper string Through this bearing piece as it passes each post, a bolt is introduced, by which means, the upper inside shoulders of the posts are relieved, and the load conveyed in a measure direct from the posts to the arch braces. This mode of construction combines the system of panel bracing with arching, the arch braces serving to relieve and assist the panel braces and *vice versa* —each being without the other a perfect structure. Another great desideratum is that the support is not at all points equal, but the strength of the frames increase with the strain; this is effected by bolting the posts to each arch brace as it passes between them, and thus giving to each set of posts as they approach the abutments or piers an additional brace, and adding strength in the proportion it is required—supposing the number of panels should require six arch braces running to each bearing point, you then have by this mode of structure, for, say the third panel posts (in addition to the heel and toe shoulders for the panel braces) form bearings by bolts to the different arch braces, together with their own proper arch bearings against the upper centre string.

In addition to the structure as above described, with a view to relieve still further the shoulders in the second and third panel posts from the pressure of the panel braces (these points being more especially affected by the load and the reaction) short open braces are well secured by means of bolts and keys to the panel braces and are made to bear against a third shoulder in the posts.

The mode of footing the arch braces renders it easy to regulate their bearings by means of wedges—the strings of each truss frame project about three feet beyond the end panel posts over each abutment, about twelve or fifteen inches from their termination, two parts are erected side by side, and secured by the strings in the same manner as the panel posts; against these, on their inner side, and resting on the lower strings, is placed a hard wood block or casting, well secured, and formed with steps to receive the arch braces. On the outer side of these end posts at the right angle formed by them with the lower strings, are placed strong cast iron brackets to assist the end shoulders of the strings in receiving the thrust of the arch braces. Over the piers a sufficient space is left in the strings between the last panel posts of each span, to erect bearing or thrust posts and allow blocks or castings for the foot of the arch braces to be placed on each side of them.

Where the span is of great length and the elevation will admit, we perceive by a drawing, that instead of using one lower centre string, two are applied, making four lower strings to each truss, the object in framing thus is to apply the arch braces at a better angle, by passing them between the centre strings to a point in the abutment or piers below the seat of the bridge—the abutments and piers in such cases are built with an offset to receive a cast iron shoe, formed with steps for the ends of the braces. To guard effectually against any rupture at the splices in the lower strings where the strain may be very great, a double set of strings are applied to these break joints with each other, and thus prevent all possibility of separation.

For the American Railroad Journal and Mechanics' Magazine.

OFFICE OF THE NEW YORK AND ERIE RAILROAD CO.—Owego, April 15th, 1840.

GENTLEMEN—I herewith forward to you, *specifications* for the *materials and construction* of the Susquehannah division of the New York and Erie railroad, presuming that their publication in your valuable Journal, particularly that portion of the road that is to be constructed upon *piles*, would be acceptable to your readers generally.

This division, extending from *Binghampton* in Broome county, to *Hornellsville* in Stuben county, along the valleys of the *Susquehannah*, the *Chemung* and the *Canisteo* rivers, *one hundred and seventeen miles* in length, was put under contract February 10, 1840—to Messrs. Manrow, Higinbotham & Co.—to be completed by July 1st 1842.

The contractors are men of established reputation, and possessing a perfect knowledge of the manner of constructing a railroad upon piles, having been engaged as practical engineers, and superintendents upon the Syracuse and Utica railroad during its construction.

Over *one hundred miles* of this division will be constructed upon *white oak* piles, according to the accompanying specifications, at a cost of *fifty*

per cent. less than the *original* estimates for a *graded* road. Sufficient *white oak* timber is now being cut, and delivered along the line of the road, in the counties of *Tioga, Chemung* and *Stuben,* to construct *thirty-six* miles of *pile* road. *Six* of *Cram's patent steam pile drivers,* from the shops of *Pond, Higham & Co.*, of Utica, will be put in active operation by the middle of May, each one of which, will drive *one mile* of pile road per month, making the *thirty-six* miles by November next. The cross-ties will be placed upon the piles as fast as they are driven, and the longitudinal rails and iron during the ensuing winter.

An abundant supply of suitable *white oak,* is found within a short distance of the road. It is purchased by the railroad company for *half stock,* at par, and *half cash,* at an average price of 2½ cents per lineal foot for *piles* and *cross ties,* and $12 per thousand feet, board measure, for the rail timber, delivered on the line, making the whole cost of timber less than $2,000 per mile. The entire cost of the *pile road* will not exceed $7,000 per mile, including an iron rail plate of *forty* tons to the mile, making one of the *cheapest* and most *permanent* roads that can possibly be constructed.

An examination of the *specifications,* will convince *all* of its *permanency,* and a knowledge of its advantages, will convert the *skeptical* to its practical *utility.* The superior advantages of a *piled road* (independent of *economy*) only requires to be understood to be fully appreciated by every unbiased mind.

If time permits, I may hereafter endeavor to show the relative merits of the two modes of construction, as practically tested, upon railroads now in successful operation in this country.

The maximum grade on the *Susquehannah division,* is thirty feet per mile, for short distances, on straight lines, and the minimum radii 1,910 ft. on *level* grades. *Two-thirds* of the whole curvature will exceed 6,000 ft. radii, and *five-eighths* of the whole distance will be on tangent lines.

Yours respectfully, C. B. Stuart,

Chief Engineer Susquehannah division New York and Erie railroad.

The specifications referred to in the above communication will be found in another part of this number.

COMPARATIVE ADVANTAGES OF RAILWRYS AND CANALS.

We extract the following condensed views on this subject, presented more than ten years past, in Silliman's Journal, when railways were in their infancy. We understand they are from the pen of a distinguished Civil Engineer, now among the first in this State, Mr. E. F. Johnson. Had these views been listened to, the mania for canals, caught from our success with the Erie canal, would not have infected all parties. We should not have passed the laws for the construction of the Chenango canal, the enlargement of the Erie canal, the Black river and Genesee Valley canals—works that will entail on us a debt of fifty millions of dollars, without corresponding advantages, whilst on the branch canals, it is reasonable to assert, the public would now prefer railways.

1. "The resistance to be overcome on a level railway increases only at the same ratio with the speed, while on a canal all increase of speed is met by more than a quadruple ratio of resistance.

2. The facilities which railways afford for rapid rates of travel in the employment of steam. Rapidity of conveyance, in the intercourse of a country is of the first importance.

3. Canals must be made almost on a dead level, and the elevations must be overcome by expensive locks; whereas, railways may be so laid as to overcome an elevation of many feet to the mile.

4. Canals are often broken and rendered useless, till they receive extensive repairs and their locks frequently become defective and must be rebuilt at greater expense—railways are but little liable to interruptions of any kind.

5. Canals are often deficent in water in times of drought, while railways are in perfect order—railroads can be laid on summits, which afford little or no water for a canal.

6. Railways can be used at all seasons of the year, while canals in latitude 43 to 44, remain inoperative five to five and a half months in the year, and this too at the best season for disposing of agricultural products. This advantage alone, other things being equal, must give to railways an entire preference over canals. The experience on railways in England and in the United States is decisive on this point.

7. Canals are but imperfectly calculated to answer the wants of the travelling public—while railways afford the safest and best of all possible facilities for the purpose, and this too at a season of the year when our canals and rivers are closed, and when even our roads are next to impassible by the ordinary modes of conveyance.

8. Railways tend to drain the soil on which they are laid, while canals promote the increase of stagnant waters and unwholesome effluvia—a consideration of great magnitude.

9. Railways occasion less general hazard and loss of life than canals.

10. Railways occasion no obstruction in passing common roads, while canals require expensive and troublesome bridges.

11. Rivers are easily passed by railways on good bridges, canals require expensive aquaducts.

12. Railways afford more general accommodation to the country than canals, by enabling the occupants of farms to make outfits for market by branches.

13. The use of railways does not result in the deterioration of morals which usually attends the business of canals. A single person is sufficient to conduct a load on a railway, and his attention is necessarily engaged by the duties of his employment.

14. Much danger and loss is sustained on canals by *leakage of boats* and other casualties from which railroads are exempt. The business of the latter requires no inrurance.

15. The cost of a railway, is not more than half of that of a canal *through the same route.*" [In the instance of the enlargement of the Erie canal to 7 feet by 70 feet—a double track from Albany to Buffalo, will not cost one-fourth the sum necessary to enlarge the canal, to wit, $100,000 per mile. The railway will have four times the capacity of the canals, for general transportation at all seasons of the year.]

16. "Railways will in no case interfere with the right to the use of streams and water privileges—the reverse with canals.

17. Lines of railroad may in general be made more direct than canals, as in laying out the latter we are obliged to conform to the natural surface of the country."

In additton to the foregoing, it may be stated that,

The advantages of railways in a military point of view are of the first importance for cheap national defence. With steam frigates, for batteries in our harbors—aided by the prompt transit of troops of the United States, and the militia from the interior, the expense of large standing armies may be avoided.

In the event of war with England, the connection with Maine and the upper lakes by railways will save their cost in the transportation of munitions of war for defence. Railroads from Maine to New Orleans, and into the interior for the transit of the United States, mails are of the first consideration to commerce, and the defence of our sea-coast. They will be superior even to telegraphs. Troops can follow the signals, for the defence of any point attacked.

Experience, both in this country and Europe, has demonstrated the great superiority of railways. In New England, the Blackstone, Middlesex, and Farmington canals have been superseded by railways. The Delaware and Rariton canal is a failure, and a dead weight on the Camden and Amboy railroad. The Philadelphia and Baltimore railroad has taken the business from the Delaware and Chesapeak canal. The Baltimore and Ohio railroad is destined to supersede the Chesapeak and Ohio canal. After these facts, we would ask what is to become of the Chenango, the Black river and Genessee valley canals? The Erie canal, being on a thoroughfare desined to be the greatest in the world, *may* sustain itself. If the enlargement is continued to the size of seven feet by seventy, the counties on the tier of the Erie canal will get *money distributed in their region*, but the result will be to drive cheap transportation to the railroad, and by lake Ontario and the Welland canal to the upper lakes; and last, not least, prostrate the credit of the State.

J. E. B.

The road complete.—We are happy to state the entire route of the Wilmington and Raleigh railroad is completed. And passengers coming through on Sunday passed over it in the cars. We congratulate the public & the enterprising projectors on this happy consumation of a great work, and trust that it will prove as profitable as it is honorable to the Stockholders.—*Char. Mercury*, 10*th inst.*

Important Railway Discovery.—The Prussian State Gazette informs us that a M. Kalkenhimer has invented a new kind of carriage for railways, which will cost only 2500f. 100*l.* each, and which may be moved at the rate of six French leagues in an hour, without steam or horse-power. It states that a carriage containing 24 persons may be moved with the force of a single man.

☞ The price of freight on the Boston and Providence railroad, has been reduced from $5 to $3 per ton. The charge to passengers had been previously reduced from $2 to $1 50.

We learn also that the fare for passengers from Springfield to Boston is only $2 50.

☞*Cheap Travel.*—The price of the fare on the railroad from Boston to Dedham, (distance ten miles,) was reduced, a week or two since, from 37½ cents to 25. Since the reduction, the weekly receipts of the road have nearly doubled.

Chesapeake and Ohio Canal.—On Saturday, the 4th instant, a public

meeting was held at the Conrt-house in Hagerstown, which was attended by a large number of the citizens of Washington county of both politcal parties, the object of which, as stated by the chairman, Gen. O. H. Williams, was to take into consideration the propriety of calling an extra session of the Legislature of Maryland for the purpose, when convened, of making an additional appropriation for the completion of the Chesapeake and Ohio Canal to Cumberland. Mr. Thomas, President of the Canal Company, addressed the meeting, and, in the course of his remarks, as noticed in the Hagerstown Mail, stated that the present means of the Company were not more than sufficient to pay its debts, and that without further appropriation the work must stop—contended that a stoppage of the work, even for a time, would materially effect the credit of the State, and ruin many of her citizens. He showed the condition of the State finances, as connected with the canal, and urged with much zeal and earnestness the policy of making a further appropriation to the canal company at this time. H. H. Gaither, Esq. spoke in opposition, and was replied to by R. M. Tidball, Esq. in favor of an extra sesion and an immediate appropriation to the canal,

Resolutions were passed, setting forth the necessity of an appropriation and the propriety of an extra session at an early day for that purpose, and expressing the belief that an appropriation to the canal company would have been made at the last session if there had been a full attendance of the Senate when the canal question was acted on. A commitee of seven was appointed to communicate the resolutions to the Governor.

EIGHTH REPORT OF F. R. HASSLER, AS SUPERINTENDENT OF THE SURVEY OF THE COST OF THE UNITED STATES, AND OF THE CONSTRUCTION OF STANDARDS OF WEIGHTS AND MEASURES; RENDERING ACCOUNT OF THE WORKS OF 1839.

Upon the survey of the coast.

1. The proper organization and course of operation in a geodical work of such extent as the survey of the coast of the United States, is dictated by the nature of the country, and the relative position of its parts; presenting a long stretch of very unequal coast, with only such a breadth as the exigences of the work required; this dictated to begin at such an approximately central part of the country as would present the most facility and best prospects for large triangles, to serve as foundation of the work, and produce the greatest quantity of data for that purpose in the shortest time; presenting, also, within its limits, a locality for a base line of proportional length, and the necessary facility for its accurate measurement, from which the work might afterward spread in both directions of the country simultaneously, and alternately, as circumstances would dictate or allow.

2. Thence the work was begun in the neighborhood of New York sound, Long Island and its large sound, etc., which evidently present the requisites and qualifications above stated. The works of preceding years had filled up with the main and secondary triangulation, and the topographical, as well as the hydrographical detail, most part of the district from the Jersey shore of the Raritan and New York bay, till towards the east end of Long Island, the sound, and opposite islands, the shore of the main land of New York, Connecticut, till Black Point, etc.

3. The field works of this last season were in some measure a beginning of the stepping over from the eastern side of these works to the southwestern, to open on that side, also, the field for the topographical and hydrographical detail works through the southern parts of New Jersey, part of Pennsylvania, to the seashore of Jersey, along Barnegat Bay, and the Delaware.

4. All the survey of Long Island, as well the topographical, as the hydrographical part of its outer seashore on the south, and that of the sound to the north, had been completed the preceding years, till to Gardner's bay, of which a part of the sounding remained yet for this year.

5. The works of this year on the northern shore of the sound, include, as well the topographical, as the hydrographical surveys of Block Island, the numerous islands of Fisher's sound, and others, the shore of Connecticut, and Rhode Island, with their deep inland waters, from Black point, where the hydrographical works had ended last year, through the whole of Fisher's sound, so that the work reaches now on that side of the shores and waters of the eastern States.

6. The surveys on land were carried inland as far as the nature of the coast on one side, and the time on the other, dictated or allowed; always furnishing, to the hydrographical party, which is carried on parallel with the works on the shore, the fundamental points to ground their determinations of the points of sounding upon them; these works occupied one of the sounding parties, and a number of topographical parties.

7. The other sounding party finished the works in Gardener's bay, thence round Block Island, along the shores of the row of islands, turning up to the main, and a part of the main shore, in continuance of where the other party left off, from the side of Fisher's sound; a part of the same topographical parties furnishing the determining land points as always usual.

8. A second part of the work to be executed this year, in that eastern part of the survey, was the topography of the parts, between the country near the shore, surveyed with reference to the sounding more especially, and the limit of the main triangulation, farther in the interior; the former having always been accelerated in its progress, so as to assist constantly the hydrographers in their progress on the water, it could not be carried sufficiently deep, land inward, for all the wants of the survey in general, this part of the topographical works was therefore to be completed, and it required yet some secondary triangles to complete it, besides the plain table works. It appears, however, that the season will not serve long enough to prevent operation if it fall yet in next year's work. But this will not prevent the house works of maping, which are intended to be done the coming winter for that part of the country.

9. A work similar to the above, but of much smaller extent, was executed on the west side of the New York and Raritan bay through the county from the North river near the sloat on the west side of the Hudson river, corresponding opposite to Tarrytown, on the east side of it, which is the boundary point from which the work, which has just been mentioned, starts towards the east.

The western limit of this work following the Newark mountains, and the triangle points established upon them, until to their intersection with the Raritan river behind New Brunswick, and to the parts surveyed as shore line in that part of the country.

10. Thus the survey of the whole country from the New Jersey shore of the Raritan bay, Sandy Hook, and Shrewsbury, till to the waters of the eastern States is completed in topography and hydrography, grounded upon and included in, a great number of secondary triangles, which themselves are based upon the main triangulation.

Only over a small portion, at the east end, the primary triangulation does not yet reach, but the secondary triangulation is accurate enough, and near enough to the main triangles upon which they are grounded, to secure against all doubts upon sufficient accuracy for the detail operations of topography and hydrography. When the main triangulation will be again

carried to that side of the work, it will soon cover it over. The whole of the works presents to the south in some measure a straight line, from which the work will proceed southerly through New Jersey and Pennsylvania.

11. Views for the guidance of the navigator approaching the shore as mentioned in the last report, have been made last summer by one of the assistants, on the whole extent of the outside coast of Long Island, and at such places of the eastern part of the sound, as were found properly the hydrographic parties, who had of course to lead the selection of these points; these are of two kinds, the one guiding, the other warning. The first are aspects of the shore from the most important points of a channel or entrance of a port, etc., by which the seaman is guided in his proper course in approaching. The second kinds are views taken from rocks, shoals, or other dangerous places in the approaches of the shore, which the view given shall warn him to avoid.

12. In extension of these principles, the views of every light house were taken double, first from the habitual ship channel at a distance at which vessels would habitually pass it, and second from the proximity, where the light house becomes entirely visible, and so near as to warn from nearer approaching unless special views of landing, etc.

The south shore of Long Island is well known for its dangers by the multiplicity of shipwrecks on it; therefore special direction was given to draw views from the habitual ship channel outside, at every short interval, or in some kind of moving panorama, by which the approaching seaman may reconnoitre the part to which he is near, and guide himself in his course by the views which he is thus shown that he shall meet in succession in his intended course.

13. From Sandy Hook southerly, the Jersey seashore, with Barnegat bay, and a certain breadth along the inner shore of the same, has also been surveyed, till down to the neighborhood of Egg Harbor river. This part of the shore is difficult of access, from the interior by triangulation, on account of the heavy wooded, but low hills which separate it from the other land of Jersey, so that it will become unavoidable to cut through the forests in various places, to get lines for triangles, joining this work to the interior parts in several places, in order to bind up with accuracy the long series of small operations, necessitated by the peculiar difficulties presented by the nature of the locality. The hydrographical part of the same locality was also intended to be begun, but as it could not be attended to this year, it will form the first work for sounding vessels next spring.

14. The extension of the secondary triangulation over New Jersey, between the Raritan bay, the Delaware and the seashore, for which the accurate first elements are given by the main triangulation, carried entirely to the same extent; and from the southern line, stated above, for all other works, was carried in advance of the main triangulation the most favorable points. This same operation has been continued this year more southerly, so as to lay out triangles for further extension westerly, to join the head of the Chesapeake, including in its course the northern monuments of the so called Mason and Dixon's line.

15. It is well known that the meridional parts of this Mason and Dixon's line has been applied to conclude upon the length of a degree of the meridian in that country and latitude, and that the result has been used, in former times, by European mathematicians, in their comparisons with the other measurements of degrees in different parts of the world, but gave so unsatisfactory results as to be always rejected. It will, therefore, be of interest in the course of the present survey, if ever possible to verify the meridional distance, by means of the triangulation for the coast survey, and the

latitudes of the two end points, either by the same, or by new astronomical observations.

16. The scientific account of the operation being recorded in the transactions of the London Philosophical Society, that part can be easily verified. But the monuments placed on the ground may, or may not, be found again in the old places, with the necessary accuracy to warrant proper confidence. In the archives of the State of Maryland such documents exist as may give a clew to designate the localities of them. Therefore there have been already some researches made upon the subject, and the verbal accounts of the persons living in the neighborhood may fully lead and decide upon the application of the diplomatic documents, that will be found to the locality when compared upon the spot. Whatever may be the result, this investigation is of scientific interest, and can, therefore, not be passed over uninquired or unverified in a work like the coast survey, passing over the same ground.

17. From some proper points below Philadelphia, there will be a branch of the triangulation carried on easterly towards the sea, to join the topographical works made along the seashore, Barnegat bay, etc., as stated above, and also southerly to Cape May and Cape Henlopen, at which point it will be proper to join again both these two series of triangles.

18. The place of Cape Henlopen light house must form a point of the main triangulation, though lying somewhat out of its shortest course, to bind up and compare with all accuracy, the results of the latitude and longitude determinations, made there on the occasion of the passage of Venus over to the sun in 1769; which is another scientific work, executed in that neighborhood in the last century, and a more interesting one than the preceding, it being generally considered as more accurately executed.

19. This summer the main triangulation has been carried on through Jersey, from the triangle points lying in the district of the works first enumerated, southerly to the neighborhood of Philadelphia; how far it may be possible to continue it south of it, must of course depend upon the weather, which at this time of the year is very uncertain. Over all this district the secondary triangulation must necessarily next year be carried more into details, and the topographical parties will also begin operations in it.

20. The main triangulation having been begun earlier this year than the former, more stations of it have been executed, and it will be brought as soon as possible, in following years, to the head of Chesapeake bay; the part of the country thereby obtained will then present again a systematic mass of work, connected so as to form the elements of another series of maps and data for publication, similar to the works now executed and above enumerated.

21. The results of the whole work in triangulation, topography, and hydrography, as far as obtained, the end of last year, were last spring collected together in one map, upon the scale $\frac{1}{100000}$, as already noticed in my last report as bugun; every separate sheet of work is there numbered, as it is in the register of the works, and its limits marked, so that any execution of maps, within the limits of the work, can be guided by this preliminary in some measure tangible register of the works; the same system is, of course, to be pursued in future.

22. It will be a special question to decide in each case of executing any map from the coast survey works, upon what scale it shall be executed, according to the different aims and purposes; this register map will in all cases give the means to form appropriate plans upon that subject, calculate the size and position of the whole map of the sheets, or any part of them.

23. During the coming winter the assistants will again be occupied as in the preceding ones, only the calculations being of a somewhat different nature, principally relating to the systematic junction into one body, of the results of the trigonometric operations that have been executed; all the calculations are always to be made three-fold; being now numerous, much of the time of the assistants will be used in it, and as well this as the reduction of some of the works to ultimate maps for final execution, will occasion to keep some of the assistants engaged in this work, instead of in the field work.

This arrangement is well appropriated to the work in its present stage, and, at the same time, agrees with the state of the balance remaining from the last appropriation, as it will postpone some of the expenses of the field equipments.

24. This will make ready for any final execution for drawing, etc., the whole extent of the coast and country adjacent, from the New Jersey shore to the end of Rhode Island shore, in the topographical and in the hydrographical parts.

This part of the coast, forming, in some measure, a whole work by itself, containing about three thousand square miles, will therefore be taken in hand immediately, for final execution upon two different scales, for the different purposes, to which they must naturally serve in future.

25. The map of the bay and port of New York, which has been especially mentioned last winter, as desired to be published, forms an essential part of this work, and will, of course, be attended to the first, with this view, for which arrangements are in progress.

26. A provision of the best quality of large drawing paper, appropriated to our work from the manufactory of Aunounay has just been announced as having arrived in New York for our use.

27. With the view to prepare for engraving maps, copper plates have been ordered in Vienna from Hungarian copper, on account of its best quality: these have just been announced as being under preparation, and that they may be expected in a few months: they will, therefore, certainly arrive before actual use will press for them.

28. In respect to the appropriation for the coast survey, to be proposed to Congress at the next session, I have only to state that it will be most economical for the best progress of the work, that Congress would please to appropriate $100,000, as I had taken the liberty to propose last year, because it will be necessary to begin incurring special and new expenses, for the arrangements and provisions required for executing final drawings, and begin to engrave. If the final appearance of the maps, when published, shall do justice to the trouble and expense incurred in the survey, the whole must came out of one systematic establishment, from which nothing should go out without the stamp of the establishment.

29. It is not proper, nor in fact possible, to separate these works from the drawings consequent upon the coast survey generally, because the works naturally interlock in one another, so that no distinct account can be kept, nor the works be detached from the assistants, who have worked at them in their origin; there should, therefore, be applied for the final drawing the necessary preliminary expenses of different kind of engravings, &c., such moneys of the appropriation total as may be needed, and the whole will enter into one mass of expenditure, like it is one system and map of work.

30. Except these establishments, and the expenses which must naturally be incurred in consequence thereof, there will be no change in the assistants employed, and the general arrangements and organization of the

work, so that it is expected the diminution of some of the field expenses, as mentioned above, will about cover the additions which the last two sections show as necessarily to be added in the present state of the work;—this presents a stepping over towards its full fruition at an epoch of its age shorter than I believe can be shown in other similar work.

(Continued from page 224.)

SPECIFICATIONS FOR THE MATERIALS AND THE CONSTRUCTION OF THAT PART OF THE NEW YORK AND ERIE RAILROAD WHICH IS TO BE BUILT ON PILES—THE SUSQUEHANNAH DIVISION.

Specification of the manner of clearing for pile road.

For a space of *twelve* feet on each side of the centre line, all trees, standing stumps and trunks exceeding 15 inches in diameter, are to be chopped off to a height not exceeding *one* foot above the surface of the ground, and all trees, stumps, trunks and bushes, less than 15 inches diameter, are to be cut withing *six* inches of the surface of the ground.

The remaining portion of the company's land, on each side of the above mentioned space of *twenty-four* feet, are to be cleared by chopping all trees stumps, standing trunks, and bushes, to a height not exceeding *two and a half* feet from the surface of the ground. All the timber, wood, logs, brush, and decayed logs and rubbish, included in the above mentioned space of 24 feet, together with the wood, timber and brush on the remaining portions of the company's land, are to be secured and compactly piled, or stacked along the outward bounds of the company's land. The brush, limbs, and other timber and wood, as far as the engineer may deem advisable, is to be burned up and destroyed.

The timber for the piles and superstructure is to be as follows:

The *piles* are to be of *straight and sound* WHITE OAK. not less than *eight* feet in length, and not less than *ten* or more than *sixteen* inches in diameter at the butt. At least *one-half* of the piles are to measure *one foot* or over, at the *butt*, without the bark.

Said piles are to be delivered along the line of said railroad at such points and in such quantities as they shall be required for use, and as the engineer of such division shall direct, and shall be subject to his inspection. All piles which in his opinion are unfit for use, shall be rejected.

The *cross-ties* are to consist of *perfectly sound* WHITE OAK OR CHESTNUT STICKS, not less than *nine*, nor more than *thirteen* inches in diameter at the small end, and *sawed* in lengths of *nine and one-half* feet. No stick shall be more than *three* inches larger at the *butt*, than at the *top* and *one-half* of the whole number, shall not be less than *eleven* inches in diameter at the *small end*. Each stick is to be cut from the *body* of the tree *below the limbs*, and is to be straight and free from loose knots or other defects. The said *ties* are to be delivered on the line of the said road, as directed by the engineer, in heaps of not less than *ten*, or more than *twenty-five* in each, and are to be inspected on or after delivery by the said engineer, who shall have power to reject all that are in his opinion unfit for use.

The RAIL TIMBER, is to consist of *perfectly sound*, square edged WHITE OAK timber, free from *wane and shakes*, sawed on *four sides* true and even so as to make a stick *precisely seven* by *eight* inches. The said timber is to be entirely free from *black* or *loose knots*, and delivered in lengths of *sixteen, twenty, twenty-four, twenty-eight* or *thirty-two feet*, exclusive of stub-shot, and *one-half* at least to consist of sticks *twenty feet long* or over.

Said timber is to be inspected on or after delivery, by the engineer of

said division, who shall have full power to reject every stick which is in his opinion unfit to be used in said road.

It is also to be delivered and suitably piled along the line of said railroad, at such points as shall be directed, in piles of not less than 500 nor more the 1,000 lineal feet, each laid up true and even, to prevent the rails from springing or warping. The whole to be done in a workmanlike manner, and to the *entire satisfaction* of the said engineer.

The TIMBER for the SILLS, is to consist of *sound* WHITE OAK, PINE or HEMLOCK, free from *shakes* and *sawed* on *two sides*, so as to make a stick *six inches thick*, and not less than *twelve inches wide* exclusive of *wane* on the bottom or wide side; and no sill is to be less than *ten* inches, exclusive of *wane*, on the narrow side.

Said SILL TIMBER is to be delivered in lengths of 16, 20, 24, or 28 ft. and *one-half*, at least, is to be *twenty feet* long or over. The said timber is to be delivered along the line of said railroad, at such points, and in such quantities as the enginneer may direct, and is also to be subject to his inspection, and all sticks which are in his opinion unfit for use, shall be rejected.

The manner in which the pile road is to be constructed.—The piles.

The piles are to be driven perpendicular, four feet apart, *longitudinally*, and six feet apart *transversely*, from centre to centre. In all cases where the ground will permit it, each pile is to be driven at least five feet below the surface of the earth, and to be driven until it reaches a *solid bottom*, or a *point* where owing to the firmness of the earth, the pile cannot be driven by the hammers used in driving, more than two inches at one blow. In case the pile driven shall not be long enough to reach the solid bottom, or the point aforesaid, then it is to be sawed off, and another pile of the requisite length is to be connected with it, by a suitable pin placed in the heart or centre of each at the point, and then the two are to be driven, until the lower end of the second pile is at least five feet below the surface, and as much further as may be necessary, to reach the hard bottom or the point aforesaid.

After being driven to the point or depth required, each pile is to be sawed off at right angles with the pile, and on a line corresponding with the grade of the road, as indicated by the grade line designated by the engineer having charge of the work. In case each pile is not sawed off at right angles, and on the grade line as aforesaid, by the pile driving machine, the same shall be otherwise adjusted, so as to allow the cross tie a full bearing on the top of the pile. Upon the top or upper end of each pile after it is driven, a tenon is to be framed for the notch in the cross tie which tenon is to be *two* inches in height and *nine* in thickness, and of the same width of the cross tie, and to be so constructed that the cross tie will shelter the pile from rain and snow.

Cross Tie.

The lower side of each tie is to be framed to the top of the piles, by a notch cut across the same *nine* inches wide, and of a depth sufficient for the tenon on the top of the pile, and so adjusted that it shall have a bearing on the tenon of at least *nine* inches, and shall also protect the top of the pile from rain and snow. In the upper side of the tie suitable notches are to be cut, for the longitudinal rails, of sufficient width for a rail *seven* by *eight* inches in width and thickness, to be fastened by a wedge *eighteen* inches in length, *four* inches wide, and *one and a half* inches thick at the *large* end. The notch for the rail to be as deep as the thickness of the tie will permit, and still leave a neck of *four* inches in thickness, and the

bearing of *nine* inches on the top of the pile. The *centre* of the tie is to be on a line with the *centre* of the track; and the distance to the outside shoulder of the tie, is to be *precisely three feet six inches* from the centre of the tie.

The outside shoulders of the ties are to be on a parallel line with the rail, and the inside shoulders are to be framed on an angle, to correspond with the shape of the wedge when driven to its place, so that the middle of the wedge shall be on a line with the centre of the tie and notch. Every alternate wedge is to be driven in a direction differing from the other, so that no *two* wedges or any *one* tie shall be driven in the same direction.—The ties are to be framed and fitted to the tops of the piles in a workmanlike manner, and firmly pinned to them by a white elm tree nail *one* foot in length, and *two* inches in diameter, being in form *eight square.* The tree nails are to be driven through the necks of the ties, at least *eight* inches, into an auger hole, *two* inches in diameter, in the top of the piles, which said tree nails are to be secured to the tops of the ties by proper wedges *two* inches in width and at least *one* inch in length.

The rails are to be fitted into the notches with precision, in a workmanlike manner, with tight joints, and firmly wedged with the wedges above described. The rails are to be champered off *one* inch from the inside line of the rails, on an *angle* of 45 degrees from the top line of said rails, in a workmanlike manner. Both rails are to be parallel to each other, and the proper distance from the centre line of the road. The iron bars are to be *three* inches in width, and *three-quarters* of an inch in thickness, and are to be spiked on to the above mentioned white oak rails firmly on a line with the champered edges of the rails, and laid true and even to a guage of precisely *six feet* in width, between the iron rails. And plates are to be fitted snugly into the rails *two-thirds* of their thickness at the joints of the iron bars. The space allowed between the ends of the bars for expansion is to be *one-quarter* of an inch. The spikes are to be fitted to the iron of the proper length, and driven in a workmanlike manner.

When the piles are driven in a strait line, so that each shall be under the rails and on the line, strong braces shall be framed firmly, into both the ties and piles, with shoulders of at least *two* inches, to support the bearing of the rails and ties.

Specification for that part of the road which is to be graded by excavations and embankments.

The timber is to be cut close to the ground, *forty feet* on each side of the centre line; from which space, all trees, saplings, bushes, and other vegetable matter shall be cut up, and together with logs, brush and wood of every description, shall be removed or destroyed. When excavation or embankment occurs, not exceeding *two* feet in depth or height, all trees, saplings and bushes, to be grubbed up, and together with all logs, brush, and wood of every description shall be removed or destroyed. Where spoil banks are to be placed, the timber to be cut down, and if required by said engineer, to be cleared off. In all cases the trees, saplings and bushes are to be cut near the ground, and cleared off to the distancd of *forty feet* each side of the centre line of said road. All *loose* or *vegetable* earth, shall be excavated and removed from the foundation of the embankment, for such width as may be directed by the engineer. The earth to be excavated and removed, and embankments raised as may be necessary to produce an uniform and regular surface, conforming to the inclination or level indicated by the levels and field notes of the said engineer. The excavations shall be *thirty-two* feet wide on the graduated line of the road, and a

side drain of such slope and dimensions as may be directed by said engineer, shall be formed on each side of the road. The sides of the excavation and spoil banks to have a slope of *one and a half* feet horizontal to *one* foot vertical measure. The earth from the excavations shall be carried into the valleys or hollows, to form the embankments, as far as the said engineer may direct. The surplus earth shall be formed into spoil banks, with evenness and regularity and with as little injury to the adjoining levels as may be; and all trees, logs, stumps, roots and bushes, shall be turned up or disposed of with like precaution; nor shall any unnecessary injury be done to the owner or owners of the adjoining lands. The spoil banks shall be formed with a suitable descent to carry the water off from the road and the inside line of their base shall be back *ten* feet on each side from the outside line of excavation, as may be directed by said engineer, to form birms to lead the water from the road; the said birms to be excavated and formed to such level as may be directed by the said engineer, and when directed by the said engineer, drains shall be left through the spoil banks to carry off the water. All earth necessarily excavated in road ways or ditches, shall be estimated as excavation. When the earth to form embankments, cannot be obtained from the excavation, then it shall be taken from such place as the said engineer may direct. The sides of the embankments shall have a similar slope to that specified for excavation, which embankment shall be *fifteen feet* wide on the *top*. No stump, logs, or other perishable matter, shall be put in the embankment, and it shall be carried up level and uniform so as to settle as even and firmly as practicable. No public or private road which crosses the railroad shall be obstructed by excavation or otherwise, until direction shall be given by said engineer, to complete the work across said road or highway; nor shall any crops of grain, grass or vegetables, nor any dwelling house or other building, nor fence, be disturbed unless by the direction of said engineer. In any case where it may become necessary, for men or teams to pass any fence, gate or bars, in going to and from their work, care shall be taken to prevent any injury, that might occur to crops of grass or grain, on adjoining fields, by leaving fences, gates or bars open, or imperfectly closed. Any damages that may occur by such neglect, shall be determined by said engineer, and deducted from his estimate of the value of work done under this contract. The embankment for bridge landings, shall be of such dimensions and form as may be directed by the said engineer. The smaller class of culverts, squared drains, and sluice-ways, abutment walls, and piers, are to be laid in mortar, unless otherwise directed by the engineer, and are to be built of the usual sized building stone, in a substantial manner, faced and bound, with the corners firmly bedded, and in all respects are to conform to the directions of the engineer. All stone work to have plank foundations, unless otherwise directed. The timber sluice-ways are to be made by sinking a mud sill firmly and evenly to a depth of three feet below the surface, and framing in *five verticle posts* 12 by 12 inches square surmounted by a *cap-piece* 12 by 12 fastened on by mortice and tenon.—The rear of the abutments to be planked. *Seven* sound white oak string pieces 8 by 15, are then to be laid on the two bents, and covered with 2½ inch hemlock plank, secured by tree nails.

Specification showing the manner of making the superstructure for the graded road.

The timber for the graded road is to be of the qualities and dimensions required by the specifications herein before stated. After the *road bed* is levelled off, as required by the specifications and contracts for grading, the

sills are to be sunk in trenches to be dug *six inches* in depth, and of such widths as are required to bed the same evenly and firmly, with a full bearing for their whole lengths. At the *joints* of the *sills*, the trenches are to be so formed, as to admit a *short sill* or bearing plank, *of two inches thick one foot wide* and *two feet long*, under the sills. The *tops* of the bearing plank are to be on a *level* with the bottom of the trenches.

The plank and sills are to be pounded down and well settled, with heavy mauls or commanders, so as to be firmly and uniformly bedded with a full and perfect bearing on the bottom of the trenches; and their upper surfaces are to correspond with the level or grade pegs, given by the engineer. The earth that is taken out of the trenches is to be *filled around* the sills, and well rammed down to prevent the water from settling under them. The *bank* between the *sills* and the *outer edge*, is to be rounded off, to permit the water and snow to drain off readily from the sills.

The cross ties are to be hewn flat on their bottoms, their whole length, so as to give a *true* and *full bearing* of *nine* inches, longitudinally on the sills, and are to be *spiked on* firmly with six inch spikes, *four feet* from centre to centre. The *notches* of the *ties* are to be framed in the same manner as specified for the pine road; and the remainder of the superstructure is to be constructed in every respect in exact accordance with the specifications for the superstructure for pile road.

Specification for the bridges on the Susquehannah division, New York and Erie railroad.—Foundation.

The *superstructure* is to be supported, on *timber bents*, constructed by driving piles into the ground, in all cases, where the nature of the earth will permit, as specified below.

The bearing piles are to be of *straight and sound* WHITE OAK or WHITE ELM timber hewed *square*, free from *wane* and *loose* or *black knots* and of such dimensions as are stated in the bills of materials and plans for the several bridges, according to the length of spans for each. After being driven sufficiently deep, and in *every case* to the *hard or solid bottom*, the piles are to be *sawed off* at a proper elevation to receive the cap pieces, which are to be fastened on by mortice and tenon, secured by *two inch white elm tree nails*, well wedged at their head. Each *bent* is to consist of *two rows* of piles, driven in *straight lines four feet* from centre to centre, on a line corresponding with the current of the stream. *Each row* is to consist of *five* piles for single track, and *nine* piles for double track bridges. The said rows are to be of such distance apart, as are marked on the plans or directed by the engineer. *Piles* for the necessary *ice-breakers* and *guards* are to be driven as specified and shown on the plans and to the satisfaction of the engineer.

The cap pieces and braces are to be of the same quality of the piles, and of the dimensions stated in the bills of materials, and marked on the plans accompanying the same. They are to be framed and finished as shown on said plans, in a substantial and workmanlike manner. The sides of the bents are to be planked up from *one foot* below *low water mark* to the *top* of said bents with sound three inch *white oak* plank laid *edge to edge* and strongly *pinned* to the piles. When directed by the engineer, the bents are to be *filled* with suitable *cobble stone*, in such manner as he shall deem necessary for the more perfect support and security of the foundations.

Superstructure.—Carpentry.

1st. Each stretch or span of the bridge is to be composed of *two or three* vertical truss frames, formed of *white pine* with the exception of the *posts*

2nd. The truss frames are to be strengthened as shown upon the plan, by *bolts* and *straps* of iron, and supported by *braces* and *arches* placed either under the same or upon the the sides. The floor timbers are to be of *white pine*, placed transversely and either resting upon, or properly connected on the under side with the string timbers by bolts or straps of iron. The distance between the trusses is to be *sixteen feet* for each track, The floor timbers are to be *capped* or *covered* if required, with boards *one and a half inches thick*, from *four to six* inches wider than the timbers and *grooved* on the *under edges* to prevent the access of water from above.

3d. The *whole frame* to be composed of the *first quality of square edged timber, perfectly sound, and free from black or loose knots, wind-shakes, worm holes and sap.* and to be *framed* and *braced*, according to the plans, in the most accurate and workmanlike manner, so as to secure the whole strength of the timber. Each *shoulder* and *joint* is to fit and bear with the utmost precision. The whole of the timber is to be sawed at least *six months* before being used in the work, and is to be suitably *piled under cover*, immediately after it is sawed to allow a free circulation of air through it, and prevent it from springing or warping.

Joinery.

1st. Each truss frame is to be protected from the weather, by a covering of *white pine inch boards*, placed vertically upon the *sides* and *ends*, and *matched* at the edges with a *tongue* and *groove*, so as entirely to exclude the water. Between the side covering and the timber, *furring pieces* are to be interposed *one and a quarter* inches thick. The covering is to be well and thoroughly nailed and secured to the frame.

2d. Each truss frame is to be *covered* or *caped* with a *two and* a *half* inch *white pine plank* projecting *two* inches over the siding with the *upper* surfaces bevelled so as to carry off the water. Under each projecting edge a *groove* is to be made, and a *moulding inserted* in the *angle* to prevent the access of the water.

3d. The flooring of the road way is to be composed of *sound, square edged pine or hemlock plank*, from *two* to *three* inches thick, as may be directed, well *spiked* or *pinned* to the floor timbers. The flooring is not to come in contact with the siding, of the truss frames; the *space* intervening, to be such as the engineer may direct.

4th. The *coping* and *siding* to be composed of *sound, well seasoned stuff*, free from *large* or *decayed knots, worm holes wind shakes* or *sap*, to be *smoothly planed*, and put on in a faithful and workmanlike manner.

Iron.

The *bolts* and *straps* are to be formed of the *best quality* of *American wrought iron.* arranged in a manner and of a size specified in the bill of materials and plan, and as directed by the engineer. The *bolts* to be of *round inch iron*, (driven through 7-8 auger holes,) with *substantial square heads* and *nuts* 3-4 of an inch thick, and *two inches* square, and *washers* of 1-4 inch band iron, *three inches square.* The *bolts* are to be well secured at their ends, by a *screw plate* and *nut.* The screw is to be not less than *two* inches long, with a *clear and strong thread.* When required, the *string timbers* are to be *spliced* by means of *three splicing bars* to each joint. Each bar is to be *twelve* feet long, *three* inches wide, and 3-4 of an inch thick, with a *spur* on each end, *three* inches long and 3-4 of an inch in diameter at the base. The *holes* in the bars are to correspond in size and number with those marked on the plan. The bolts are

to pass through the *splicing bars, string timbers,* and *splicing blocks*, and to be firmly secured at the ends. The bolts in the *ends* of each bar are to pass through the *posts* and to be secured as above. The bands or straps are be made of $2\frac{1}{2}$-$\frac{5}{8}$ iron, firmly *welded* or *screwed* together.

Painting.

The side and end coverings to the truss frames, to be thoroughly covered with *two good coats* of *best American white lead and oil paint.* The *coping, gallows frames,* and *outside braces,* are to be covered with *three* coats of the same kind, if not otherwise directed by the engineer. Previous to applying the paint, the *knots,* if any, are to be *well covered* with a *composition of red lead and litharge, bound with a size made of parchment or glue.*

The *road ways* of all the *bridges* to be *double* or *single* as occasion may require, and as directed by the engineer.

The work to be constructed in every respect according to the plan and bill of materials, to be furnished by the engineer, under whose supervision and inspection the same is to be erected, who will give such directions from time to time, during the progress of the work as shall appear to him necessary, to perfect the plan of the same, as contemplated by the preceding specifications,

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REPORT OF THE JOINT BOARD OF DIRECTORS, TO THE STOCKHOLDERS OF THE DELAWARE AND RARITAN CANAL, AND CAMDEN AND AMBOY RAILROAD AND TRANSPORTATION COMPANIES, ON THE COMPLETION OF THEIR WORKS.

(Continued from page 256.)

The business of the canal is now beginning to increase, and has received a new impetus from the arrangement last year made, to take the Schuylkill coal through it. For this purpose the companies have deemed it advisable to advance, on good security, for the construction of boats, and for developing the resources of the canal, the sum of one hundred and seventeen thousand dollars. The experiment has been eminently successful, and many individuals, stimulated and encouraged by the success of those, who under the auspices of the companies, have embarked in this business, have turned their attention to it, and a large number of boats are now being prepared, with decks, for the purpose of transporting coal, without transhipment, from the coal region in Schuylkill county, to New York. When these arrangements are finally completed, and the Philadelphia and Reading railroad is finished to the Delaware river, there is but little doubt that the canal will greatly increase the dividends. Add to all this, the increasing travelling of a growing country, which since the commencement of the railroad has been eleven per centum per annum, and the revival of business, and you may approximate to the real value of your investment. For ourselves, we hesitate not to say to you, that in our opinion, it is the safest and most profitable investment of money we know of, which opinion we now put on record, to be tested by experience. In conclusion, we notice, that whilst the cost of the works is six millions sixty-four thousand nine hundred and fifty-three dollars and forty-two cents, we divide only on twenty-nine thousand shares, or two millions nine hundred thousand dollars, the ballance having been borrowed at an average interest of six per cent ; which loan, forming a part of the cost of the works, will be paid by the State of New Jersey, at the expiration of the charter, as part of the consideration money, if she

elects to take the works, and which loan, there is no doubt can at that time be liquidated by the receipts of the road for three years.

Although we cannot attempt to name all the individuals from whom we have obtained advice and assistance during the progress of our labors, still we may not overlook the important and invaluable aid we have received from one of the directors, (now absent,) Mr. John Potter, of New Jersey, formerly of South Carolina. To his enterprise, firmness, and public spirit, are the public, as well as ourselves, more indebted, perhaps, than to any other individual, for the successful issue of your affairs.

The directors and officers of these companies have devoted themselves to your concerns for ten years past; and although they have not thought it necessary or expedient heretofore, during the progress of the works, to trouble you with the details of their business, or to indulge idle curiosity, by constant inspection of their books, they do now, as a proper return for your unwavering confidence in them, lay before you every thing, from a snow plough to a steamboat

The accuracy with which the accounts and books of the company have been kept, by Mr. Edwin A. Stevens, Mr. John R. Thompson, and Mr. James Neilson, is manifest from the fact, that upwards of eleven millions of dollars have passed through their hands, and their accounts, after a full examination, balanced to a dollar.

In conclusion, the directors would state, that the arrangement made in June, 1836, with the Philadelphia and Trenton railroad company, by which the receipts of the companies were amalgamated, so as to divide on the shares of the companies, share and share alike, and to equalize the dividends has been attended with the most beneficial results. Whilst it has placed the stock of a company, in an adjoining State, upon an equality with your own, it has added much to your success and prosperity.

JAMES PARKER, *Chairman of the Joint Board.*

R. F. Stockton, Robert L. Stevens, Abraham Brown, John C. Stevens, W. M'Knight, J. Kaighn, G. D. Wall, B. Fish, J. S. Green, J. W. Mickle, J. Neilson, J. R. Thomson, E. A. Stevens, *Directors.*

A DESCRIPTION OF THE DELAWARE AND RARITAN CANAL, FROM ITS COMMENCEMENT TO ITS TERMINATION, WITH AN ACCOUNT OF THE PROPERTY OWNED BY THE COMPANY.

The works of the Delaware and Raritan canal company, commence opposite Bull's Island, at Black's Eddy, in the Delaware river, 22¼ miles above the city of Trenton, and run thence along the river to Trenton, thence westwardly 6 miles, to the Delaware river at Bordentown; and from Trenton eastwardly 37 miles to the Raritan river at New Brunswick —the whole length being 65½ miles: uniting the tide waters of New York and Philadelphia; and, with an outlet lock in the Pennsylvania canal at Black's Eddy, will connect the Pennsylvania canal and the important works of the Lehigh Coal and Navigation company with New York.

From Bull's Island to Trenton, it is generally 60 feet wide and 6 feet deep. This portion of the canal was constructed to supply, with the aid of the river Raritan, the main canal between Bordentown and New Brunswick, with water, as well as for the purposes of navigation and trade.— The water is taken from the deep natural pool in the Delaware, of which Black's Eddy is a part, the bottom of the canal being below the lowest water surface ever known in that river. There has heretofore been a large surplus of water running over the waste weirs; nor can their ever

be any deficiency while there is water in the Delaware and Raritan rivers. A guard bank, extending from Bull's Island to the first guard lock, is constructed about three-quarters of a mile below the head of the island, which forms a large, safe harbor for boats, rafts, &c.; it is more than 200 feet in width, and three-quarters of a mile in length. Through the guard bank there are two culverts; one for the passage of the water to the canal, the other for water power. The work is also constructed in such a manner as to admit of the water being taken out and used for water power, on the main shore side of the lock. From this point to Prall's creek, about three miles, the canal is made by constructing an embankment in the bed of the river, along and parallel to the shore from fifty to one hundred feet distant, raised two feet above top water line of the canal, and protocted on both sides by a substantial slope wall, which will admit of the water passing over the bank during the floods. This arrangement has been found to answer the intended purpose, and has withstood the floods without receiving any injury. Across the mouth of Prall's creek there has been erected a dam of crib work, filled with stone, 200 feet in length which serves the double purpose of waste weir and dam for the creek. There is another guard lock at this place.

From this place to Trenton, about 19 miles, the canal generally passes along within a short distance from the river; but in some places the rocky bluffs made it necessary to construct high embankments in the bed of the river. In all such cases, the banks are protected with heavy slope walls, varying from 1½ to 3 feet in thickness, and from 20 to 40 feet in height. About half a mile below Lambertsville is a lock of 10½ feet lift, constructed of hammer-dressed masonry. Above this lock there is a large and spacious basin. The works at this place are likewise so arranged, that the water passing around the lock into the canal below, can be used for water power. From Bull's Island to this lock, nearly 8 miles, the bottom has a descent of two inches to the mile, and the top of the banks carried level; below this lock it has two inches to the mile.

The banks throughout the whole canal are made on a slope of two feet base to one rise, and generally lined either with coarse gravel or fragments of quarry stone. There are 14 culverts over the different streams over which this part of the canal passes, of from one to four arches, varying from six to twenty-five feet in span, and from 110 to 130 feet long. There are also a number of waste weirs, which are placed at proper distances to carry off any surplus water, which may accumulate from the drainage of the lands above. The bridges are all made to turn, so as to admit the passage of masted vessels. This portion of the canal joins the main branch, about one-fourth of a mile east of Trenton.

The main canal is 43 miles in length, 75 feet wide, and constructed for 9 feet depth of water; during the last season it has been 7 feet 4 inches. It commences at the Delaware river, near Bordentown, about 500 feet from where Crosswicks creek enters that river, and passes along the flats near the river shore, to Lamberton, thence in the rear of Lamberton, to the summit at Trenton, a distance of six miles, where it receives its water from the section above described.

Between Bordentown and Trenton there are seven locks, which overcome an elevation of 57 feet, made of cut-stone masonry, and laid in hydraulic cement, 110 feet long between the gates, and 24 feet wide; the whole length, from the head to the lower end of the wings, being 162 feet. Over the Assanpink creek, near Trenton, there is an eliptical arch of 36 feet, span 140 feet in length, and 16 feet in height, from the foundation.

From Trenton the canal takes an eastwardly direction, following the valley of the Assanpink, to Lawrence meadows; thence by a deep cut across Lawrence meadows into the valley of Stony Brook; thence down that valley, passing about a mile south of Princeton to Millstone river; thence across the Millstone on an aquaduct of 10 arches, and 100 feet in width of water way; thence along the east side of the Millstone to Kingston, about 13¾ miles. This portion of the canal is level, it being the summit; in its course it passes over several streams on arches from 6 to 12 feet span. The Shabbakunk creek has three arches, of 12 feet span each.—From Kingston the canal continues along on the east side of the Millstone valley; in some places it passes so near to the river as to require a slope wall to protect the embankment; but generally it passes along at the foot of a red shell bluff which bounds that valley on the east. At 13¾ miles, it intersects the Raritan river, where the bluff approaches so near as to re-require the canal to be made in the bed of the river by a high embankment, which runs along in the bed of the river to Bound Brook, about 2½ miles, and which has been well protected by immense slope walls and loose stone lining; thence to Follett's farm 1¾ miles, it runs along in the flats. At this farm there is a dam built across the Raritan river, 8 feet high, and about 400 feet long, and connected to the high ground on the north side of the river by a guard bank raised above the highest flats. This dam was made to let in the river to assist in case of need in supplying the canal with water. From this point to New Brunswick, 4¾ miles, the canal has been constructed, for the most part by embankments in the bed of the river, protected by a slope wall and loose stone lining.

The basin at New Brunswick is formed by the construction of a pier in the river in front of the city, from 200 to 300 feet distant from the wharves, extending nearly a mile in length, and terminating at the steamboat wharf.

From Kingston to this place there are seven locks, overcoming an ascent of 58 feet, built of hewn granite, one at kingston, one at Griggstown, one at the mouth of the Millstone, one at Bound Brook, one at Follett's, one at the upper end of the New Brunswick basin,* and one at the outlet at New Brunswick, all of the same size as those on the other side of the summit, except the last, which is 30 feet wide, and 130 feet long between the gates, the whole length from the head to the lower end of the wings being 185 feet. There are besides several culverts over the different streams, from 6 to 20 feet space. All the mason work throughout the canal is laid in hydraulic cement. Waste weirs have been constructed throughout the line to carry off the surplus water, of which there has been a great deal during the last summer, although the business has been greater than at any previous time. The bridges are all made to turn, as before stated, for the purpose of passing masted vessels. At each bridge and lock there is a keeper's house. Basins of suitable size have been made at all the public landing places. Besides the banks before described there are guard banks about seven miles in length, constructed at an expense of $15,000 per mile.

* At this lock, the works have been so arranged as to be able to use the surplus water to drive machinery. At the ordinary summer height of the Raritan, the whole of its waters can be turned into the canal, and used here with a fall of fourteen feet.

A DESCRIPTION OF THE ROAD FORMATION, AND SUPERSTRUCTURE, TOGETHER WITH THE BUILDINGS AND FIXTURES OF THE CAMDEN AND AMBOY RAILROAD, AND ITS BRANCHES, FROM BORDENTOWN TO NEW BRUNSWICK, AND FROM TRENTON TO THE DELAWARE BRIDGE, AT BLOOMSBURY.

SECTION I.—*From South Amboy to Bordentown depot, distance thirty-five miles.*

This road was commenced to be graded in December, 1830. It is graded 15 feet in width, at the grade of the road; ditches 3 feet deep, 18 inches in width at the bottom, and 11 feet in width at the top, level of grade.—From Hightstown to Gravel Hill, a distance of five and a half miles, the road is graded 25 feet in width, for a double track of rails. The foundation of this road is formed by two continuous trenches, three feet in width, and one foot in depth, being filled with broken stone; over these trenches a roller, weighing three tons, was passed a number of times, until the whole was a solid mass.

On 26 miles 76½ chains, stone blocks, two feet square, 10 to 13 inches thick, were placed 3·2 feet apart, from centre to centre—embedded with small stone on the trenches; then settled with a heavy wooden driver, worked by horse power; two holes were then drilled into each stone block, (except at the junction blocks, which have four holes,) one inch in diameter, and five inches deep. Upon the stone blocks, locust chairs 14 inches long, 6 to 8 inches in width, and from 1 to 2 inches thick, are placed, and attached to the stone blocks, by tree nails driven into the holes of the stone blocks. The chairs were then dressed, to receive the edge rail, of the I from (invented by R. L. Stevens, Esq.,) 3½ inches high, 2⅛ inches on the upper running surface, and three and a half inches in width on its base, weighing 42 lbs. to the yard, is laid and fastened by spikes six inches long, with hooked heads, the ends of the bars resting upon wrought iron plates, or cast iron chairs, and are conneated together by an iron tongue five inches long, two inches wide, and five-eighths of an inch thick, with two rivets passing through the ends of the bars and tongues—oblong hole, to allow for expunctral contraction.

Seven miles and twenty-seven and a half chains are laid with cross sleepers, placed 2 feet 8 inches apart from centre to centre, of oak and chestnut, 8 feet long, 6 inches thick, and not less than 6 inches in width—embedded with small broken stone, upon the stone trenches, and consolidated with heavy hand pounders. The cross-sleepers were then dressed to receive the edge rail; to which they were fastened with hooked head spikes; wrough iron plates at the joints of the rail, and tongue fastened as before described.

Twenty-three chains of road, near South river, were laid with continuous granite sills, 12 by 14 inches, in lengths of 8 to 10 feet, on which a flat bar of iron two and a quarter inches wide, and seven-eighths of an inch thick, was attached. This part of the road was found, after experiencc of four years, to be expensive in its repairs, besides very rough and objectionable; so much so, that it has been replaced, in part, by taking off the flat rail, and substituting cross sleepers of locust, 7 feet long, and 6 inches square, transversely upon the stone sills, and placing the edge rail upon them; which have completely remedied the defects of this part of the road.

Whole distance of bridging is 2,179 feet, or 33 chains. The principal bridges, to wit, over South river, Rocky brook, at Hightstown and Crosswick's creek, have been partially renewed, upon a new plan; by which, it is believed, they will require but little repairs to the end of the charter.

It is done by covering the bridge in such a manner as to protect the superstructure from the action of the rain.

That part of the road laid with stone blocks, is of the most permanent character, and has required but a very small expenditure per mile annually, and it is believed it will continue, without renewal, to the end of the charter, with but small annual repairs. This opinion has been founded upon the fact, that at the end of the road, the passing over has been more than equal to that which, in all probability the main road will have undergone at the end of thirty years—as the engines, for eight years past, have necessarily to go from the water station to the wharf *three* times for every *one* they pass over the road; besides the running backwards and forward, to pump water into the boiler. Here the rails have not been renewed, and are still in good order.

The same applied to all the edge rail laid upon the road. The distance of 14 miles, from Bordentown depot to Hightstown, was so far completed on the 20th October, 1832, that a line of cars, drawn by horses, was placed upon it to convey passengers, and on the 17th December, 1832, the whole distance was used for the transportation of passengers and merchandise.

SECTION 2.—*From Bordentown Depot to Camden. Distance* 26 *miles* 10 *chains.*

The road bed is graded 17 feet in width—slopes of excavation and embankment, 1¾ feet base, to 1 foot perpendicular—ditches 3 feet deep, 2 feet wide at bottom, and 12½ feet wide at top, or grade of road. The whole road bed was covered with 18 inches of sand or gravel, wherever loam or clay was found at the grade of the road. The object of this being to secure the road from the unequal action of the frost, and gave, in consequence a better foundation to lay the superstructure upon.

There are six turnouts. These portions of the line, a distance of 60 chains, are graded 27 feet wide, with the same slopes and ditches as before described.

A part of this line near Camden, was commenced to be graded in March 1831, and the remaining distance in April, 1833.

The superstructure for eight and a half chains, at Camden, is laid with stone blocks, 2 feet square, not less than 5 inches thick; 5 stone blocks are placed in the length of a rail 16 feet, for the foundation. Upon these are placed locust cross-sleepers, 8 feet long, and 6 inches square; upon which is fixed an edge rail, fastened by spikes, wrought iron plates under the joints of the rails, and tongues fastened as before described.

For 31 chains, red ceder piles, 7 feet long, from 7 to 9 inches diameter, are driven into the ground every 3·2 feet for the foundation; upon the ends of these piles is placed the edge rail, fastened on the head of the piles, with the same kind of spikes; the same connection at the joints of the rails, and the same kind of wrought iron plates as before described. Twenty-nine chains of roads are laid through the street at Burlington in the same manner as the last described. These parts of the road were laid in 1833, and have required but little repairing, are apparently perfectly sound, and likely to remain so. Seventy-two chains of road, near the Pensauken Creek, are laid with wood rail, and flat iron; foundation of plank 3½ inches thick and 2 feet wide under each rail, continuous its whole length; cross sleepers of oak every 4 feet, with blocks 2 feet long, intervening; upon these sleepers and blocks, a wood rail, 6 inches square, of yellow pine, is placed; upon the wood rail, a flat bar of iron, 2¼ inches wide, and seven-eighths of an inch thick, is placed, fastened by spikes and screw bolts; the bolts passing through the ends of the iron bars and wood rail.

One mile sixty-five chains are laid with a foundation of plank, 3 1-2 in. thick, by 2 feet in width, under each rail, continued the whole distance; upon these plank, cross sleepers of red cedar, from the northern lakes, 8 feet long, 5 inches thick, and not less than 6 inches flat surface, are placed every 4 feet, and short blocks, 2 feet long, (of the same dimensions otherwise as the long sleepers,) between each space supporting the rail; upon these cross sleepers and blocks, an edge rail rests; with wrought iron plats at the joints, fastened by hooked spikes, and tongues at the ends as before described. This road was laid in 1833, and the red cedar cross sleepers appear perfectly sound.

Twenty-two miles and twenty-six and a half chains are laid in the same manner as that last described, except that the cross sleepers are of oak and chestnut, instead of cedar. This road was laid in 1833 and 1834.

Whole distance of bridging, is 1,188 feet, or 18 chains, of wood structure. Two of the principal bridges, to wit: one over Black's creek, 133 feet long, and one over the Rancocus creek, 497 feet long, have been renewed on the new plan, before alluded to in section 1.

A distance of 16 miles from Bordentown, below the Rancocus creek, was travelled upon in the winter of 1833, and the remaining distance, to Camden, in the spring of 1834.

Section 3.—*From Bordentown to lower depot near Trenton. Distance* 6 *miles.*

It was commenced in September, 1837, and passengers carried upon it in 1838. This road branches from the main line of the Camden and Amboy railroad, in the borough of Bordentown, at Prince street, following round the edge of the hill, and crossing the Crosswick's creek immediately above the mouth or entrance of the Delaware and Raritan canal; thence following the tow-path, on the right bank of the canal, to Trenton.

The superstructure of this part of the branch railroad is wood rail, and flat iron bar, except 12 chains at the commencement, which is of edge rail and cross sleepers, and 7 chains of edge rail on bridges.

The wood road, with flat iron, is laid by placing cross pieces, 3 inches thick, 9 inches wide, and 8 feet long, 8 feet apart; upon these are placed longitudinal pieces, 16 feet long, 5 inches thick, and 12 inches wide; being embedded in the earth; again upon the centre of these pieces, are placed oak, 3 by 4 inches, and 16 feet long, fastened by tree nails; upon which is put a flat bar of iron, two and a quarter inches wide, and five-eighths of an inch thick; these ends and joinings of the bars being secured by a small cast iron chair; the spikes for attaching the iron rails passing through the oak pieces into the longitudinal sill below.

One mile fifty-five and a half chains is constructed in the usual way, with shoes or mud sills, cross-sleepers and wood rail, with flat iron bar. The principal part of the timber used in the construction is of hemlock, which was saturated with lime and salt, or salted by means of one and a quarter inch holes being bored ten inches deep in the longitudinal sills, 18 inches apart; then filled with salt, and stopped with wood plugs.

There are two bridges upon this section: one over the street in Bordentown, 150 feet long, and one over the Crosswick's Creek, 323 feet long; both constructed upon the new plan before described.

Port Clinton Tunnel.—We are pleased to learn that the enterprising contractors have effected a junction between the east and west workings of the Tunnel at Port Clinton. This is indeed most acceptable inteligence, and we are gratified with the zeal of the company and contractors, in spite

of hard times, to complete this magnificient work. That portion of the Tunnel under the charge of Mr. Neville required much skill in its management, and it has been happily effected with but few and slight accidents to the labours; and we view its completion as a harbinger of the successful termination of the entire route, the opening of which is so closely interwoven with the future welfare of our region.—*Miner's Journal.*

We understand that the contractors will commence laying down the rails on the road early in may, and that the work will be finished for use from Reading to Port Clinton early in October, and to Pottsville in the course of December.

STEAM BOAT FIRE ENGINE

An experiment was made day before yesterday, with a newly invented Fire Engine, just completed by Mr. Creed, and intended for the use of steam boats, and other purposes where it can be stationary. The main principle is the same as that of any fire engine, or force-pump, but the adaptation and application are new. It is arranged so as to stand in a very small compass upon the deck, where it is to be cased over and secure from damage. It can be connected with the engine, and worked by it, with tremendous effect, whenever circumstances will allow; but if fire is around the engine, as is generally the case, the fire engine may be instantly put in order to work by hand power. In five seconds after the discovery of a fire, water may be poured out from this engine to any part of a boat, at the rate of *four hundred* gallons per minute, if operated by *sixteen* men. Nor is this all—should a boat strike a snag or sawyer, or be otherwise injured so as to leak, this engine will pump out and throw over the water at the rate above named; which, in our river navigation, would enable almost any boat to run ashore, before it could sink. Such are the purposes and advantages of this invention, and the little machine, being so placed as not to be in danger from fire itself will afford ample security to any steamboat against any disaster from that cause. A boat may be nearly drowned in five minutes, so that no fire could prove dangerous.

At this exhibition, No. 12, with its powerful company, were present.

Creed's engine drew the water about 10 feet, and played into No. 12, at an ascent of about 3 ft; No. 12, was fully and strongly manned, with plenty of fresh hands to supply the places of those who found it convenient to drop off the brakes. They played with open hose, and had tough work to prevent being over-run, though they had double the number of men, and no water to lift. Playing through thirty feet of hose and fire pipes, Creed's Engine would if well manned, over-run any two engines in the city. No. 12, is said to be the most powerful engine in the city, and none has a better company—they did not like to acknowledge beat, but seemed to be pleased with this improvement as a capital thing for the uses intended. It will certainly draw and throw for a short distance an enormous quantity of water; and on one trial with hose and two pipes, one an inch and the other seven-eights in diameter, it threw two streams to a good height and upon the roofs of the buildings on the opposite side of the street. No. 12, being calculated for throwing to a distance, could of course play further and higher.

The various trials were made with apparent gratification to the Engineers of the Fire Department, and to the other spectators, as well as to the satisfaction of Mr. Creed; and we are satisfied, that for security to boats, both against fire and leakage, it is one of the best things we have seen. Its value lies in its power, simplicity, and the readiness with which it can be worked, either by the steam engine or by the persons on board.—*Boston paper.*